

## Patent claims

1. Method for establishing a data transfer link between an xDSL user modem (4) and a corresponding xDSL modem (9) within a central office (10) comprising the following steps:
  - (a) generating (S1) a wake-up bit pattern identifying the user xDSL modem (4);
  - (b) pulse length modulating (S2) an upstream data signal with the generated wake-up bit pattern to generate a pulse length modulated wake-up signal;
  - (c) transmitting (S3) the pulse length modulated wake-up signal from the user xDSL modem (4) via a data transfer medium (8) to the xDSL modem (9) within the central office (10);
  - (d) demodulating (S4) the transmitted wake-up signal;
  - (e) comparing (S5) the modulated wake-up signal with a stored wake-up bit pattern for the detection of a transmission of the wake-up bit pattern from the xDSL user modem (4);
  - (f) generating (S6) a wake-up command signal, when the wake-up bit pattern is detected for switching the xDSL modem (11) within the central office (10) from a sleep mode to an operation mode for data transfer.
2. The method according to claim 1, wherein the xDSL modem (9) within the central office (10) commences a start-up procedure when it is switched to the operation mode.
3. The method according to claim 1, wherein the wake-up signal is transmitted periodically by the xDSL user modem (4).
4. The method according to one of the preceding claims, wherein the xDSL modem (9) within the central office (10) is switched from the operation mode to the sleep mode when the data transfer is finished.

5. The method according to one of the preceding claims, wherein a detection counter (51) is incremented when the wake-up bit pattern is detected.

5 6. The method according to one of the preceding claims, wherein the wake-up command signal is generated when the detection counter (51) reaches a threshold value.

7. The method according to claim 6, wherein the threshold  
10 value is adjusted.

8. An xDSL data transfer system for data transfer comprising at least one xDSL user modem (4) connected via a data transfer medium (8) to a corresponding xDSL modem (9) within  
15 a central office (10), wherein the xDSL user modem (4) generates a pulse length modulated wake-up signal for switching the corresponding xDSL modem (9) within the central office (10) from a sleep mode to an operation mode.

20 9. The xDSL data transfer system according to claim 8, wherein the xDSL user modem (4) comprises generating means (16) for generating a wake-up bit pattern identifying the xDSL user modem (4), and  
25 modulating means (18) for the pulse length modulation of an upstream data signal with the wake-up bit pattern to generate the pulse length modulated wake-up signal, wherein the pulse length modulated wake-up signal has a spectrum within the xDSL upstream frequency band.

30 10. The xDSL data transfer system according to one of the preceding claims, wherein the generated wake-up bit pattern comprises 16 bits.

35 11. The xDSL data transfer system according to one of the preceding claims, wherein each bit of the wake-up bit pattern

determines the duration of a pulse length of a pulse of the pulse length modulated wake-up signal.

12. The xDSL data transfer system according to one of the preceding claims, wherein the level of the wake-up signal is less than a predetermined maximum PSD-level.

13. The xDSL data transfer system according to one of the preceding claims, wherein the xDSL modem (9) within the central office (10) comprises:  
demodulating means (19) for demodulating the received analog pulse length modulated signal;  
storing means (22) for storing a wake-up bit pattern which identifies a corresponding xDSL user modem (4);  
15 comparing means (21) for comparing the received demodulated signal with the stored wake-up bit pattern; and  
wake-up command generating means (25) for generating a wake-up command to switch the xDSL modem (9) from the sleep mode to the operation mode, when the demodulated wake-up signal is  
20 identical with the stored wake-up bit pattern.

14. The xDSL data transfer system according to claim 13, wherein the demodulating means (19) of the xDSL modem (9) comprises a gain sequencer (26) for amplifying the received  
25 analog signal with an adjustable gain;  
rectifying means (27) for rectifying the amplified signal;  
a low-pass filter (28) for filtering the rectified signal;  
and  
a comparator (29) for comparing the filtered signal with an  
30 adjustable threshold generating an asynchronous pulse train which is supplied to the bit pattern comparing means (21).

15. The xDSL data transfer system according to one of the preceding claims, wherein the bit pattern comparing means  
35 (21) comprises  
a synchronization means (43) for synchronizing the asynchronous pulse train with an internal clock signal;

a pulse length detecting circuit (44) for detecting the pulse length of each pulse in the synchronized received pulse train and generating a logical bit value corresponding to the detected pulse length;

5 a register (47) for temporarily storing the received bit pattern;

a comparator (48) which compares the received bit pattern with the stored wake-up bit pattern and increments a counter (51), when the received bit pattern and the stored wake-up  
10 bit pattern is identical.

16. The xDSL data transfer system according to one of the preceding claims, wherein the wake-up command generating means (25) generates the wake-up command, when the counter  
15 (51) reaches an adjustable threshold value.

17. The xDSL data transfer system according to one of the preceding claims, wherein the xDSL modems (4, 11) are VDSL modems.

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18. The xDSL data transfer system according to one of the preceding claims, wherein the data transfer medium (8) is a telephone line.

25 19. An xDSL user modem (4) comprising  
a generating means (16) for generating a wake-up bit pattern identifying the xDSL user modem (4); and  
modulating means (18) for the pulse length modulation of an upstream xDSL data signal with the generated wake-up bit  
30 pattern to generate a pulse length modulated wake-up signal, wherein the pulse length modulated wake-up signal has a frequency range within the xDSL upstream frequency band.

20. An xDSL modem (11) within a central office (10)  
35 comprising:  
demodulating means (19) for demodulating a received analog pulse length modulated signal;

storing means (22) for storing a wake-up bit pattern  
identifying an xDSL user modem (4);

comparing means (21) comparing the received demodulated  
signal with the stored wake-up bit pattern;

- 5 wake-up command generating means (25) for generating a wake-up command to switch the xDSL modem (9) from a sleep mode to an operation mode, when the received bit pattern is identical with the stored wake-up bit pattern.